PATENT SPECIFICATION

DRAWINGS ATTACHED

1,040,385

1,040,385

Date of Application and filing Complete Specification March 16, 1965.
No. 11168/65.
Application made in United States of America (No. 410642) on Nov. 12, 1964.
Complete Specification Published Aug. 24, 1966.

Index at acceptance: —F1 C(2B3B, 2B3D)
Int. Cl.: —F 04 d, F 05 c

COMPLETE SPECIFICATION

Centrifugal Compressors and Pumps and Diffusers therefor

We, UNITED AIRCRAFT OF CANADA LIMITED, a Canadian Corporation, of 1000 Marie Victorin Boulevard, Jacques Cartier, Province of Quebec, Canada, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in the construction of centrifugal compressors or pumps, and to improvements in a diffuser for such centrifugal compressors or pumps.

In most engines of the type with which the invention is concerned, an impeller is arranged to deliver air through a diffuser to the combustion chamber at high velocities. In most prior art diffusers, an arrangement of diffuser vanes is arranged in circumferentially spaced relationship about the impeller leaving a relatively narrow space therebetween in order that diffusion of the mass flow occurs at this point. Since such mass flows are normally of extremely high velocity, it is necessary to provide means for preventing or reducing shock waves. Accordingly, each of the diffuser vanes utilized for this purpose must be provided with a profiled leading edge directed towards the impeller and great care must be taken in the profiling of these edges and the assembly of the vanes relative to each other and the impeller if losses are to be avoided and a geometrically balanced diffuser is to be obtained. Obviously in order to obtain the desired profile, extreme care must be taken in their finishing, generally accomplished by machining.

According to the present invention there is provided in a centrifugal compressor or pump of the type having an impeller, a diffuser comprising an annular member having an inner and an outer circumference, a plurality of passages in said annular member extending from said inner circumference to said outer circumference thereof, the centre lines of said passages being substantially tangent to a common tangency circle, said centre lines being also adapted to intersect the centre line of adjacent passages at a distance outward from the common circle having a length which is equal to or less than the radius of said passages, whereby said passages will intersect to form a diffusion area.

Preferably, but not necessarily, the present diffuser construction embodies an annular impeller surrounding member having a plurality of circumferentially spaced passages extending therethrough substantially tangent to a common circle, with each adjacent passage disposed so that it intersects into the next adjacent passage about the inner circumference of the annular member. Therefore, the centre lines of the passages must intersect at a point wherein the distance from the point of intersection of the centre lines of the adjacent passages to the common circle is equal to or less than the radius of the passages. In other words, substantially elliptical openings are formed by the adjacent passages breaking through tangentially at the inner circumference of the annular member, intersecting and overlapping each other leaving an uninterrupted annular space or opening in the annular member surrounding the periphery of the impeller blades. The intersecting sides of the passages defining the edges of this opening are nearly circular if left otherwise unfinished, which may produce in some cases a somewhat undulating or wavy edge which can be reduced by increasing the number of passages and/or increasing their diameter.

Trumpet-like diffusers are intersected in each of the passages bored through the annular member so as to increase the initial diameter of each passage as it extends outward in order to decelerate the flow as the

mass flow proceeds through the widening portion, increasing the static pressure.

Having thus generally described the nature of the invention, particular reference will be made to the accompanying drawings showing by way of illustration a preferred embodiment thereof, and in which:

Figure 1 is a partly sectional view of the impeller and diffuser as seen downstream of the impeller section to show the intersecting passages in the diffuser ring in accordance with the invention.

Figure 2 is a cross-sectional view of Figure 1 as seen along the line 2—2.

Figure 3 is an enlarged detail view of a portion of the diffuser ring shown in Figure 1 to illustrate more clearly the intersecting passages.

With particular reference to Figure 1 of the drawings showing by way of illustration a portion of a turbine engine wherein an impeller 10 is mounted for axial rotation about a centre shaft 12. The impeller 10 is provided with blades 13 and the annular diffuser member 16 of the invention is mounted externally so as to surround the outer tips of the blades 13 as shown most clearly in Figure 3.

A main feature of the present invention resides in the formation of a plurality of passages 14 in the annular member 16 in order that each passage extends into the adjacent passage as shown. While the passages 14 are shown as being straightsided cylindrical borings, it is contemplated that they could be conical, pyramidal or any other formation without departing from the scope of the invention. The centre lines of passages 13 are tangent to a common circle, as seen in cross-section through the plane of the circle. However, the centre lines of the passages 14, may be inclined at a moderate angle with respect to the plane of this circle while remaining substantially tangential to the circle. Each adjacent passage 14*b* intersects a previous passage 14*a* at a small distance *d'* from the circle of common tangency. Distance *d'* must be equal or smaller than *r'* the radius of the passages 14. If *d'* would be greater than *r'* the intersection of the passages would leave a solid segment between the openings formed by the adjacent passages. By having the passages 14 intersect in the prescribed manner, a continuous diffusing space or zone 20, Figure 2, is provided about the impeller blades. The proper leading edges substantially corresponding to the distribution of flow are provided by the edges left by the intersecting passages.

The number of passages 14 provided in the annular diffuser member 16 is dependent on the volume and conditions of the mass flow to be diffused. So long as at least one of said tangent passages 14 intersects an adjacent tangent passage in order to form a flow diffusion space 20, any practical number of passages may be formed.

Each of these passages 14 is enlarged at the outer end to accommodate one of a plurality of tapering trumpet-like nozzles 18 which are mounted on the annular member 16. As the air flow leaves the impeller blades, it is forced into the diffusing zone 20 at high speeds. The flow enters each passage 14 and as it progresses through the suitably scheduled nozzles 18, deceleration occurs thus increasing the static pressure.

As will be obvious, by reference to the accompanying drawings and preceding description, the present diffuser construction provides good geometry in fabrication, relatively low cost in manufacture and a good aerodynamic configuration. The present design also makes it possible to vary the capacity of the diffuser ring to suit any requirement by varying the number and dimensions of the passages 14.

The above description relates to one embodiment of the centrifugal discharge means. It should be obvious that other centrifugal discharge means, such as pumps which are used for pumping liquids, slurries and other fluids could also be constructed within the scope of the invention embodying the above-mentioned characteristics.

WHAT WE CLAIM IS:—

1. In a centrifugal compressor or pump of the type having an impeller, a diffuser comprising an annular member having an inner circumference and an outer circumference, mounted about the periphery of said impeller, a plurality of passages in said annular member extending from said inner circumference to said outer circumference thereof, said passages being substantially tangent to a common circle and said passages being adapted to conduct fluid at high velocities, each of the tangent passages intersecting an adjacent tangent passage in order to form an uninterrupted annular space in said annular member and about the impeller periphery forming a flow diffusion area.

2. A centrifugal compressor or pump as claimed in Claim 1, wherein each of said passages terminates in a trumpet shaped extension adapted to create a deceleration of said fluid.

3. A centrifugal compressor or pump as claimed in claim 2, wherein said trumpet-shaped extensions protrude outwardly from the outer circumference of said annular member.

4. In a centrifugal compressor or pump of the type having an impeller, a diffuser comprising an annular member having an inner and an outer circumference, a plurality of passages in said annular member extending from said inner circumference to said outer circumference thereof, the centre lines of said passages being substantially tangent to a com-

mon tangency circle, said centre lines being also adapted to intersect the centre line of adjacent passages at a distance outward from the common circle having a length which is equal to or less than the radius of said passages, whereby said passages will intersect to form an annular diffusion area in the member.

5. In a centrifugal compressor as claimed in Claim 1 or 4, a centrifugal diffuser characterized in that the annular member passages are cylindrical in formation for at least a portion of their length.

6. A centrifugal compressor or pump having an impeller, characterized in that an annular discharge member is provided, said annular discharge member having inner and outer circumferential surfaces concentric with the axis of said impeller and being located as to surround said impeller, a plurality of borings in the annular member in spaced relationship and consituting fluid passages therethrough extending from the member inner circumferential surface to said outer circumferential surface with said passages being substantially tangent to a common circle, and that each passage intersects an adjacent passage at a point within said annular discharge member at a point spaced outwardly from said inner circumferential surface to provide an annular passage about said inner circumferential surface disposed in line with and surrounding the outer periphery of said impeller, whereby fluid discharged from said impeller flows into said annular passage and from this passage through said fluid passages and out of said annular member, the intersecting passages acting to smooth the discharge flow of the fluid.

7. A centrifugal pump as claimed in claim 6, characterized in that the pump is used for pumping liquids, slurries and other fluids.

8. In a centrifugal compressor of the type having an impellar, a diffuser comprising an annular member having an inner circumference and an outer circumference and being mounted about the periphery of said impeller, a plurality of passages in said annular member extending from said inner circumference to said outer circumference thereof, said passages being substantially tangent to a common circle with at least one of the tangent passages intersecting an adjacent tangent passage in order to form a flow diffusion zone in said annular member adjacent the impeller outer periphery.

9. A centrifugal compressor as claimed in Claim 1 or 4, characterized in that said passages have defining walls intersecting the defining walls of adjacent passages providing leading edges at their intersection disposed within the diffusion zone and adapted to engage said flow of fluid in order to prevent diffuser entry losses.

10. A centrifugal compressor or pump substantially as described and as shown in the accompanying drawings.

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Leamington Spa: Printed for Her Majesty's Stationery Office by the Courier Press.—1966.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained

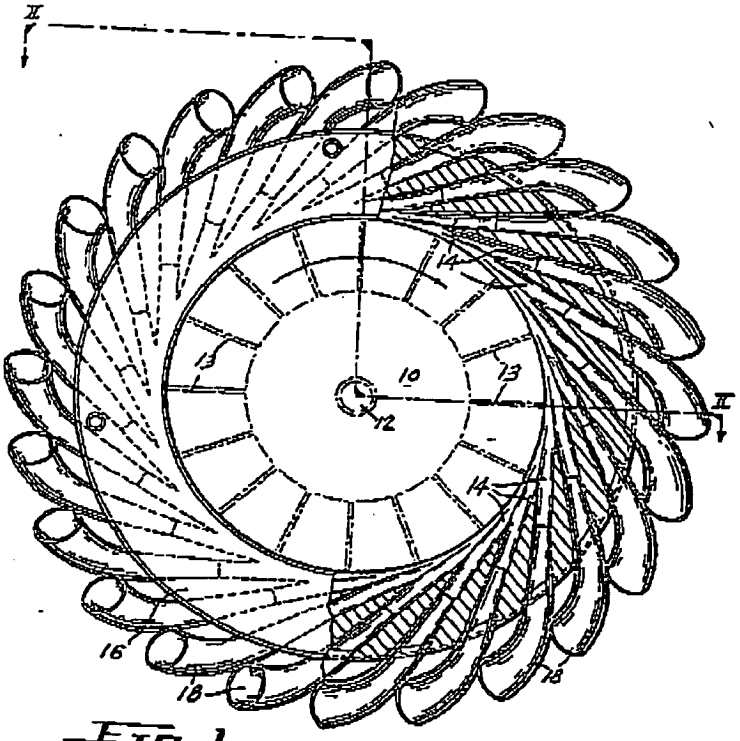

Fig 1

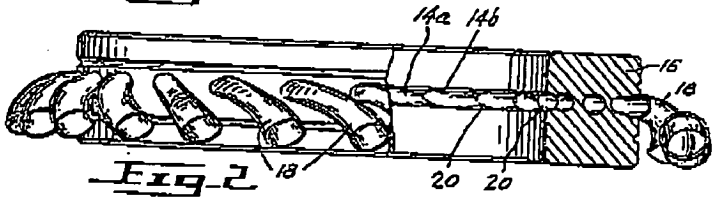

Fig 2

1040385 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 1 & 2

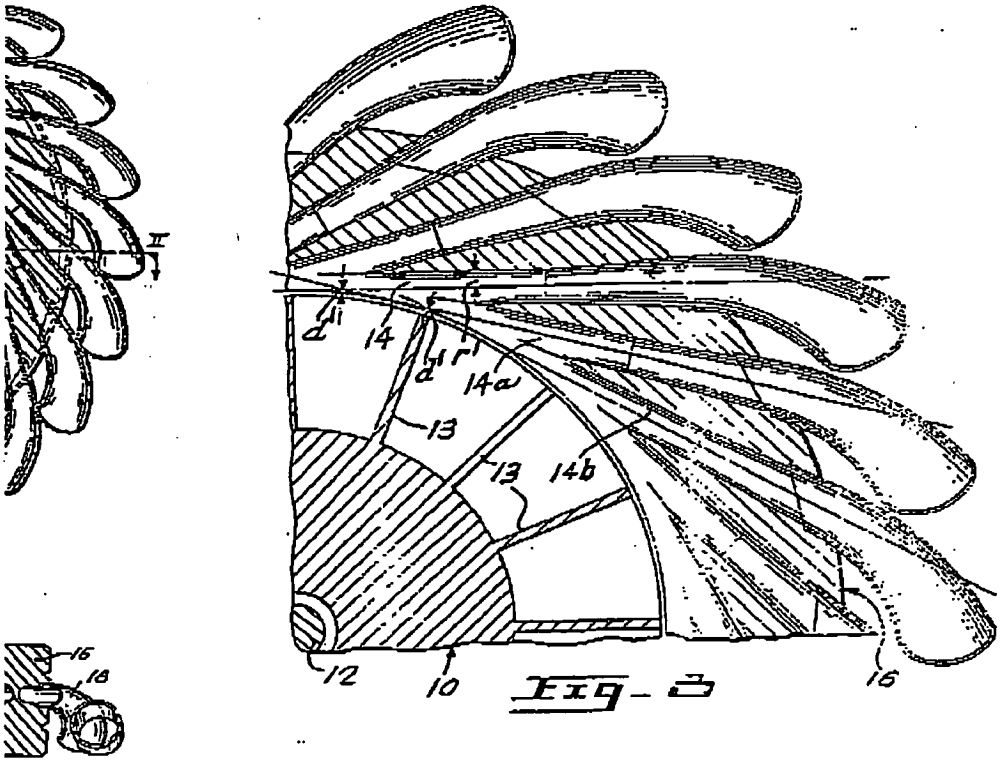

Fig - 2

1040385 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
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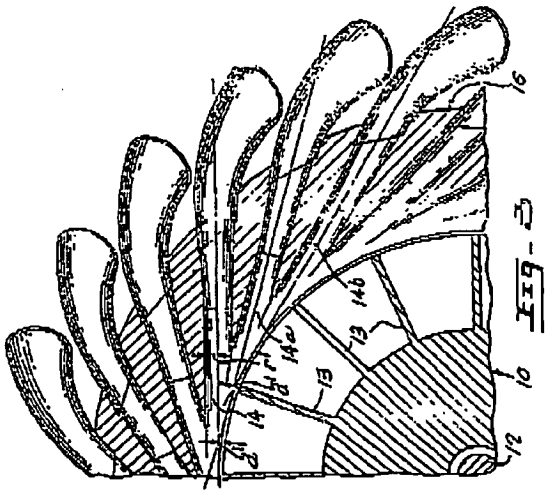

Fig. 3

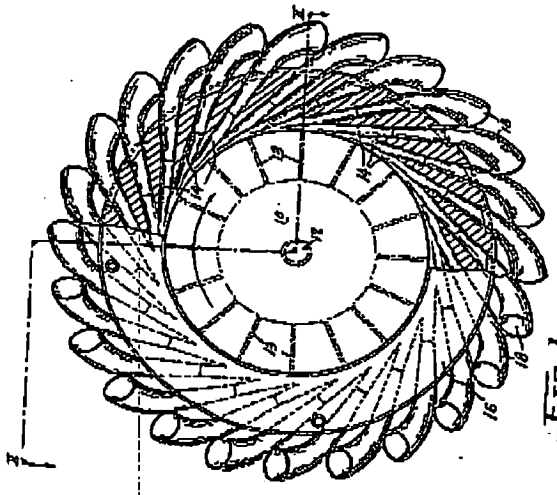

Fig. 1

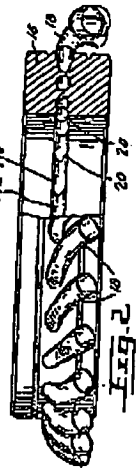

Fig. 2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 03/01008

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